International Journal of Applied Research

ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2019; 5(2): 199-202
www.allresearchjournal.com
Received: 25-12-2018
Accepted: 27-01-2019

Shankaraiah Katla
Department of Applied Geochemistry, UCS, Osmania University, Hyderabad, Telangana, India

Sathish Kumar Golla
Department of Applied Geochemistry, UCS, Osmania University, Hyderabad, Telangana, India

Correspondence
Shankaraiah Katla
Department of Applied Geochemistry, UCS, Osmania University, Hyderabad, Telangana, India

Geophysical investigation for sub surface soils characterization in mohidummeda vagu area, central Telangana, India

Shankaraiah Katla and Sathish Kumar Golla

Abstract
Geophysical investigations have been carried out using Vertical Electrical Sounding (VES) technique based on electrical resistivity method; The Schlumberger electrode configuration has been utilized to study the sub surface soil classes in Mohidummeda Vagu area. The study will be useful to civil engineers and policy makers and ultimately benefit Farmers, through proposed and implemented Irrigation facilities. The study area geologically comprises of Peninsular Gneissic Complex of Archaean age. The granite gneiss is widely distributed in this area. Remote sensing and GIS application technology have been used to prepare the thematic and base maps. The geophysical investigation reveals that depth to hard rock is varying from 0 to 8 Meters.

Keywords: Electro resistivity survey, geology, RS & GIS and mohidummeda vagu area

1. Introduction

Geophysical investigation is the science that explains mechanics of soil and rock and its applications to the development of human kind. Engineering geophysics investigates specific characteristics of subsurface materials usually to maximum depths of some hundreds of meters. Even though geophysical survey has been used in the previous with sporadic achievement, best results are very probable when it is utilised properly (Thakur *et al*. 2007) [11]. It is maximum worthwhile when it is operated in a well-unified research strategy where elucidation can be verified and distinguished. Geophysical surveys are well uitlised not only in academic research but also used in industry. Geophysical survey results can be used to guide civil engineers during their civil engineering works like tunnelling to provide irrigation water through tunnels. The gravitational as well as magnetic fields originating from the Earth's interior grasp decisive information regarding seismic activities and the inner structure. Henceforth, detection and analysis of the electric fields is very fundamental.

2. Study Area

The study area alignment length of 6.900 Km. for electro resistivity survey is covered in Bejjenki, Koheda and Chigurumamidi mandals of Karimnagar district and situated in South-Western part of Karimnagar district, Telangana State and it is covered in 1:50,000 Scale Survey of India Top sheet no. 56N04. The resistivity survey alignment is passing through Mohidummeda Vagu. About 98% of the alignment lies between Mohidummeda Vagu & Yellamagadda Vagu. These two vagus are merging each other at near Ramench village and finally merged in Lower Maneru reservoir near Karimnagar city which is one of the 100 smart cities as selected under 100 smart cities programe of central Government of India.

3. Electro Resistivity Methodology

The occurrence and distribution of different types of geological formations in the study area and the physical properties of geological material in its 3-dimensional space have been mapped using Remote Sensing and GIS technologies (Ramanjaneya *et al*. 2004) [10]. However, to delineate the vertical disposition of different layers of geological material having specific physical property in each geological formation and to ascertain their exact thickness to pass through, geophysical investigation employing the electrical resistivity survey was conducted for alignment length of 6.900 Km. Due to tectonics and geomorphic processes, the solid rock formations in their vertical dimension give rise to the following types of geological components having distinct engineering properties.

Table 1: Engineering properties of geological components

S. No.	Type	Nature
1.	All Soil (AS)	In-Situ or Transported overburden comprising of unconsolidated sediments
2.	Hard Disintegrated Rock (HDR)	Weathered geological material
3.	Fractured Rock (FF)	Massive rock with closely spaced fissures/joints/fractures
4.	Hard Rock (HR)	Compact and massive rock

(***Source:*** NRSC 2008)

3.1 Geophysical Method employed for investigation

Vertical Electrical Sounding (VES) technique of electrical resistivity method utilizing the schlumberger electrode configuration is highly favored for study of sub-surface geological formations because of its field logistic advantages in addition to the fact that it yields useful information about the sub surface geological formations (Maiti *et al*. 2011) [5]. Hence, the investigation by VES technique was chosen as they give information about the thickness and nature of geological formation at any desired location.

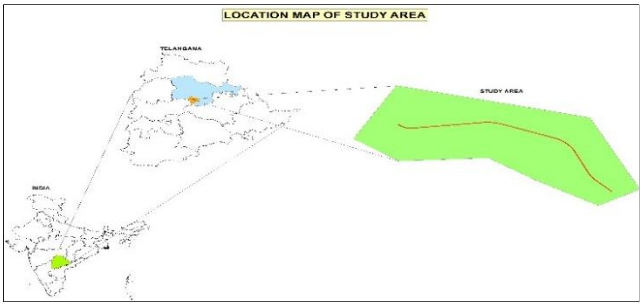

Fig 1: Location map of the study area

The VES method is based on the estimation of the electrical conductivity or resistivity of the medium and the estimation is performed based on measurement of voltage of electrical field induced by distant grounded current electrodes. The first step in the conventional method of interpretation of schlumberger VES data set involves the plotting of measured ρa values in Ohm against half of the spread length current electrode spacing on a log-log graph sheet to obtain sounding curve.

The sounding curve is then interpreted using the partial curve matching technique which involves segment by segment matching of the VES curve with two layer model master curves and associated auxiliary curves to obtain the layer parameters (i.e. the layer resistivity & thickness).

Hence the vertical electrical soundings were taken at every 100 meters interval along the survey alignment of Mohidummeda Vagu area length of 6.900 Km. The soundings were conducted with a maximum current electrode separation of 200 mts. and minimum of 100 mts. so that the electrical basement is clearly reflected in the sounding curve.

4. Results & Discussions

The study area alignment is passing through following geological formation:

Peninsular Gneissic Complex (PGC)

Peninsular Gneissic Complex of Archaean age, comprising of three types of rock units - i) two varieties of granitoid rocks (older granodiorite - admellite and younger granite - alkali feldspar) ii) undigested patches of older metamorphic rocks and iii) bands of migmatites resulted from intermixture of the granitoids and the older metamorphic rocks (RGNDWM 2008) [6], (Padmaja *et al.* 2011) [7], (Radhakrishna *et al.* 2004) [8]. Among these three rock units, granite is widely distributed throughout the area. It is grey to pink, medium to coarse grained, porphyritic to non-porphyritic and massive (Chadwick *et al.* 1989) [1], (Coffin *et al.* 1994) [2] and (Gupta *et al*. 2003) [3]. It has no higher topographic levels which forming denudational hills, dome shaped mounds (inselbergs) and boulder outcrops (Ramakrishnan *et al.* 2009) [9].

Geomormologically Most of the land forms in this area are Pediplain moderately weathered (PPM) and Pediplain shallow weatherd (PPS) lands. Pediplains are origins as a result of exhaustive weathering under semi-arid climatic situation, on behalf of final phase of the cyclical corrosion (Shankaraiah *et al.* 2015) [4].

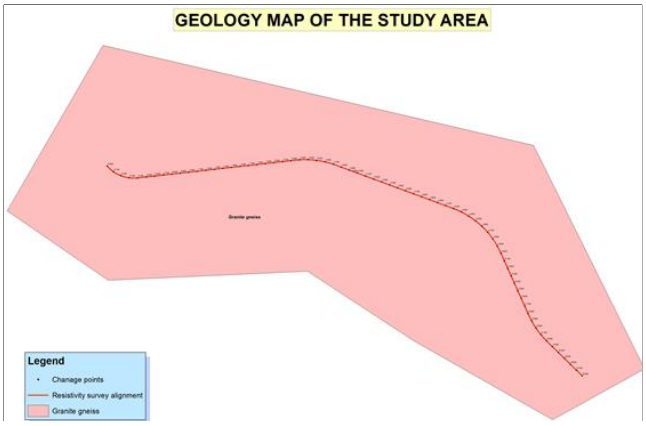

Fig 2: Geology map of the study area

4.1 Analysis of resistivity data

The field data obtained during the survey was interpreted using two layer model water curves and associated auxiliary curves and the interpreted data was expressed in terms of layer resistivity and thickness of different layers in the geological medium. The interpreted data of sounding conducted along the survey alignment is discussed here under.

Table 2: Vertical electrical soundings data sheet of Mohidummeda vagu

Vertical electrical soundings for mohidummeda vagu													
Ves No	**KM**	**ρ1(Ω)**	**h1(m)**	**h1 soil type**	**ρ2(Ω)**	**h2(m)**	**h2 soil type**	**ρ3(Ω)**	**h3(m)**	**h3 soil type**	**ρ4(Ω)**	**h4(m)**	**h4 soil type**
1	0.000	32	3.000	ALL Soils	54	3.000	HDR	96	2.500	F&F	>150	∞	HR
2	0.100	24	3.500	ALL Soils	65	2.500	HDR	100	2.500	F&F	>150	∞	HR
3	0.200	18	3.000	ALL Soils	60	3.000	HDR	106	3.000	F&F	>150	∞	HR
4	0.300	20	3.000	ALL Soils	45	3.000	HDR	105	3.000	F&F	>150	∞	HR
5	0.400	25	6.000	ALL Soils	63	2.000	HDR	88	1.000	F&F	>150	∞	HR
6	0.500	28	6.000	ALL Soils	54	4.000	HDR	110	3.000	F&F	>150	∞	HR
7	0.600	39	6.000	ALL Soils	62	1.000	HDR	105	2.000	F&F	>150	∞	HR
8	0.700	40	7.000	ALL Soils	58	1.000	HDR	104	2.000	F&F	>150	∞	HR
9	0.800	35	3.000	ALL Soils	50	1.000	HDR	105	2.000	F&F	>150	∞	HR
10	0.900	32	2.500	ALL Soils	62	1.500	HDR	110	2.500	F&F	>150	∞	HR
11	1.000	45	3.000	ALL Soils	65	1.000	HDR	106	2.000	F&F	>150	∞	HR
12	1.100	30	2.500	ALL Soils	70	1.500	HDR	106	2.000	F&F	>150	∞	HR
13	1.200	22	3.000	ALL Soils	75	1.000	HDR	104	2.000	F&F	>150	∞	HR
14	1.300	36	3.000	ALL Soils	75	1.000	HDR	105	2.000	F&F	>150	∞	HR
15	1.400	28	2.500	ALL Soils	70	1.500	HDR	115	2.500	F&F	>150	∞	HR
16	1.500	35	3.000	ALL Soils	68	1.000	HDR	104	2.000	F&F	>150	∞	HR
17	1.600	38	1.500	ALL Soils	65	2.000	HDR	106	1.000	F&F	>150	∞	HR
18	1.700	24	1.500	ALL Soils	52	2.000	HDR	108	1.000	F&F	>150	∞	HR
19	1.800	45	1.500	ALL Soils	60	2.000	HDR	106	1.000	F&F	>150	∞	HR
20	1.900	28	2.000	ALL Soils	65	1.500	HDR	107	2.000	F&F	>150	∞	HR
21	2.000	25	1.500	ALL Soils	55	2.000	HDR	105	1.000	F&F	>150	∞	HR
22	2.100	29	1.500	ALL Soils	52	2.000	HDR	104	1.000	F&F	>150	∞	HR
23	2.200	35	2.000	ALL Soils	55	1.500	HDR	110	2.000	F&F	>150	∞	HR
24	2.300	42	3.500	ALL Soils	62	1.000	HDR	108	1.000	F&F	>150	∞	HR
25	2.400	31	3.500	ALL Soils	62	1.000	HDR	106	1.000	F&F	>150	∞	HR
26	2.500	38	3.500	ALL Soils	57	1.000	HDR	107	1.000	F&F	>150	∞	HR
27	2.600	28	3.000	ALL Soils	49	2.500	HDR	108	1.000	F&F	>150	∞	HR
28	2.700	42	3.500	ALL Soils	60	1.000	HDR	106	1.000	F&F	>150	∞	HR
29	2.800	35	3.500	ALL Soils	65	1.000	HDR	105	1.000	F&F	>150	∞	HR
30	2.900	37	3.000	ALL Soils	52	1.500	HDR	106	0.500	F&F	>150	∞	HR
31	3.000	32	3.500	ALL Soils	69	1.000	HDR	110	1.000	F&F	>150	∞	HR
32	3.100	27	3.000	ALL Soils	65	2.000	HDR	112	1.000	F&F	>150	∞	HR
33	3.200	35	3.000	ALL Soils	70	2.000	HDR	110	1.000	F&F	>150	∞	HR
34	3.300	42	3.500	ALL Soils	75	2.500	HDR	108	1.500	F&F	>150	∞	HR
35	3.400	35	3.000	ALL Soils	64	2.000	HDR	110	1.000	F&F	>150	∞	HR
36	3.500	30	4.000	ALL Soils	68	2.000	HDR	112	1.000	F&F	>150	∞	HR
37	3.600	26	4.000	ALL Soils	70	2.000	HDR	114	1.000	F&F	>150	∞	HR
38	3.700	28	3.500	ALL Soils	75	2.500	HDR	118	2.000	F&F	>150	∞	HR
39	3.800	42	4.000	ALL Soils	78	2.000	HDR	112	1.000	F&F	>150	∞	HR
40	3.900	45	4.000	ALL Soils	76	2.000	HDR	109	1.000	F&F	>150	∞	HR
41	4.000	29	3.000	ALL Soils	72	3.000	HDR	105	3.000	F&F	>150	∞	HR
42	4.100	30	3.000	ALL Soils	70	3.000	HDR	102	3.000	F&F	>150	∞	HR
43	4.200	35	3.500	ALL Soils	75	2.500	HDR	110	3.500	F&F	>150	∞	HR
44	4.300	42	3.000	ALL Soils	66	3.000	HDR	98	3.000	F&F	>150	∞	HR
45	4.400	34	3.000	ALL Soils	63	3.000	HDR	102	3.000	F&F	>150	∞	HR
46	4.500	35	2.500	ALL Soils	58	2.000	HDR	108	3.500	F&F	>150	∞	HR
47	4.600	25	3.000	ALL Soils	62	3.000	HDR	96	3.000	F&F	>150	∞	HR
48	4.700	18	3.000	ALL Soils	60	3.000	HDR	94	3.000	F&F	>150	∞	HR
49	4.800	44	2.500	ALL Soils	55	2.000	HDR	82	1.500	F&F	>150	∞	HR
50	4.900	38	3.000	ALL Soils	57	3.000	HDR	88	3.000	F&F	>150	∞	HR
51	5.000	32	2.000	ALL Soils	48	4.000	HDR	86	2.000	F&F	>150	∞	HR
52	5.100	36	2.000	ALL Soils	46	4.000	HDR	86	2.000	F&F	>150	∞	HR
53	5.200	38	2.000	ALL Soils	48	4.000	HDR	88	2.000	F&F	>150	∞	HR
54	5.300	42	2.500	ALL Soils	54	3.500	HDR	90	1.500	F&F	>150	∞	HR
55	5.400	20	2.000	ALL Soils	60	4.000	HDR	95	2.000	F&F	>150	∞	HR
56	5.500	30	1.500	ALL Soils	52	3.500	HDR	98	2.500	F&F	>150	∞	HR
57	5.600	32	2.000	ALL Soils	60	4.000	HDR	94	2.000	F&F	>150	∞	HR
58	5.700	45	3.000	ALL Soils	75	2.000	HDR	90	1.000	F&F	>150	∞	HR
59	5.800	32	3.000	ALL Soils	70	2.000	HDR	88	1.000	F&F	>150	∞	HR
60	5.900	26	4.500	ALL Soils	72	2.000	HDR	88	1.000	F&F	>150	∞	HR
61	6.000	34	4.500	ALL Soils	75	2.000	HDR	86	1.000	F&F	>150	∞	HR
62	6.100	40	4.000	ALL Soils	70	4.000	HDR	85	1.000	F&F	>150	∞	HR
63	6.200	42	4.000	ALL Soils	65	4.000	HDR	86	1.000	F&F	>150	∞	HR
64	6.300	38	3.500	ALL Soils	55	3.500	HDR	104	2.500	F&F	>150	∞	HR
65	6.400	35	4.000	ALL Soils	53	4.000	HDR	98	1.000	F&F	>150	∞	HR
66	6.500	33	4.000	ALL Soils	56	4.000	HDR	96	1.000	F&F	>150	∞	HR
67	6.600	45	3.000	ALL Soils	52	6.000	HDR	94	2.000	F&F	>150	∞	HR
68	6.700	24	3.000	ALL Soils	55	6.000	HDR	98	2.000	F&F	>150	∞	HR
69	6.800	27	2.500	ALL Soils	50	5.000	HDR	112	3.000	F&F	>150	∞	HR
70	6.900	40	3.000	ALL Soils	58	6.000	HDR	108	2.000	F&F	>150	∞	HR

(***Source:*** CGWB2008)

The first layer (all soils) represents resistivity values ranging from 18 to 45 ohm m at a depth of 1.9 to 7 m. The All Soils is predominantly clayey in lower reach and in higher elevation it is coved by red soils. The second layer resistivity varies from 46 ohm m to 78 ohm m at a depth of 1 to 6 m and represents the semi-weathered rock (HDR). The fractures are present in semi-weathered and in hard rock and hence the values of fractured rock (82 to 118 ohm. m at a depth of 0.5 to 3.5 m) are less than the hard rock of the strata. The last layer with high resistivity values (>150 ohm. m) represents the massive granite.

5. Conclusion

The geophysical investigation using electro resistivity method of Schlumberger electrode configuration has been utilized to study the sub surface soil classes in Mohidummeda Vagu area. The study reveals that the depth to hard rock is varying from 4.5 to 13m and the study area comprises of Granite gneiss (Peninsular Gneissic Complex) of Archaen age. Geomorphologic ally most of the land forms in this area are Pedi plain moderately weathered (PPM) and shallow weatherd (PPS) lands. The study will be helpful to major and minor irrigation works, policy makers and ultimately benefit Farmers, through proposed and implemented Irrigation facilities.

6. References

1. Chadwick B, Ramakrishnan M, Vasudev VN, Viswanatha MN. Facies distributions and structure of a Dharwar volcanosedeimentary basin: evidence for Late Archaean transpression in southern India. Jour Geol Soc London. 1989; 146:98825-98834.
2. Coffin MF, Eldholm O. large igneous provinces, crustal structure, dimensions and external consequences. Rev. Geophysics. 1994; 32:1-36.
3. Gupta S, Rai SS, Prakasam KS, Srinagesh D, Bansak BK, *et al*. The nature of the crust in southern India: implications for Precambrian evolution. Geophys Re. Lett. 2003; 30:1.1-1.4.
4. Katla S, Saxena PR. Geomorphological mapping using Remote Sensing and GIS tool for landuse planning in and around Suryapet City, T.S., India. International journal of Applied Research. 2015; 1(9):616-619.
5. Maiti S, Gupta G, Erram VC, Tiwari RK. Inversion of Schlumberger resistivity sounding data from the critically dynamic Koyna region using Hybrid Monte carlo-based neural network approach. Nonlinear Processes in Geophysics. 2011; 18:179-192, doi:10.5194/npg-18-179-2011.
6. NRSC (National remote sensing center) Manual on Rajiv Gandhi National Drinking Water Mission (RGNDWM), 2008.
7. Padmaja Vuppala, Siva Sankar Asadi, Pavani S, Anji Reddy M. Remote Sensing Applications For The Management of Water And Land Resources in Rainfed Area of Prakasam District, Andhra Pradesh, India Environmental Informatics Archives. 2004; 2:885-892.
8. Radhakrishna T. The Achankovil shear zone. Abstract in Intern. Workshop on Tectonics and Evolution of the Precambrian Southern Granulite Terrain, India & Gondwana Correlations. National Geophysical Research Institute, 2004, 116-118.
9. Ramakrishnan M. Precambrian mafic magmatism in the western Dharwar craton, southern India. Jour Geol Soc. 2009; 73:101-116.
10. Ramanjaneya Reddy A. Integrated groundwater investigations and management using satellite remote sensing and GIS techniques in parts of Musi river basin, Nalgonda, Rangareddy Districts of Andhra Pradesh, PhD thesis, OU, HYD, AP, 2004.
11. Thakur VKS, Singh DN. "Evaluation of various Pedo transfer function to developing soil water characteristics curve of a silty soil." Geotechnical Testing Journal. ASTM. 2007; 30(1):1-6.